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ABSTRACT

This review of the research on aptitude-treatment interaction (ATI) discusses four methods or assumptions that might explain why ATI research has not generated the anticipated empirical support: (1) the lack of a theoretical base; (2) disagreement over what a given aptitude means and how it should be measured; (3) difficulties in defining instructional methods as treatments; and (4) the inability to generalize from context-specific results. Increased recognition of the role of prior knowledge as an aptitude variable and the more precise definition of instructional treatments are noted as recent, promising approaches to this research. Scenarios for the future are suggested which pertain both specifically to ATI research and to the more general implications of such research for instructional design. The importance of adapting instruction to individual learner characteristics such as interest and cognitive style is emphasized throughout. A list of 14 references is included. (MES)

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APTITUDE-TREATMENT INTERACTION RESEARCH REVISITED

by

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Paper presented at the 1987 Annual Meeting of the
Association for Educational Communications and Technology

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APTITUDE-TREATMENT INTERACTION RESEARCH REVISITED

Introduction

While most of us instructional designers and theorists would attest to the importance of designing instruction to meet individual student needs, we have been criticized for our failure to do it effectively. This is not to say we pay no heed to individual student needs. We are quite good at identifying prerequisite skills to a desired learning outcome and which of these skills individual students possess. Armed with this knowledge, we may prescribe at what point in the instructional sequence any given student should begin.

Instructional designers have also paid attention to adaptive learning sequences in the sense that students are individually branched to new instruction based on their current performance. When these two features are coupled with the opportunity for students to proceed at their own pace, the result appears to be individualized instruction, instruction based on individual student learning needs. So, what's the beef? A careful look at these instructional packages will reveal that although the sequence of content may be sensitive to individual differences, the learning process is virtually the same for all students. Little or no provision is made for varying student interests, learning strategies, learning styles, and the like.

Part of the reason for this situation, it can be argued, stems from the unfulfilled promise of aptitude-treatment interaction (ATI) research. This research seeks to establish relations between learner characteristics and instructional treatments that

will permit instructional designers to specify that one mode of instruction is ideal for a group of learners with one set of characteristics while an alternate method is optimal for a group of learners with different characteristics. Unfortunately, this research has yielded and continues to yield little in the way of clearcut, replicable results. Moreover, one regularly sees reported in the literature ATI studies in which the hypothesized interaction was of secondary interest and unsupported by theory or logic.

The intent of this paper is to re-examine ATI research, to reflect upon and question the assumptions we have been making in conducting this research, and to summarize some recent, more promising approaches to this research that may better serve us in the future. While the focus of the paper is on research, a related question concerns how research should inform practice. Implied in the opening remarks is a belief that adapting instruction to such individual learner characteristics as interest and cognitive style is a good thing to do. This belief will also be re-examined in the closing comments of the paper.

The Promises of the Past

The roots of ATI research may be traced to a book edited by Gagne and published in 1967 in which Cronbach and others proposed a theoretical rationale for such research and summarized some basic and applied research pertaining to it. Aptitudes were considered to include any characteristic of the learner that increases or impairs his or her probability of success in a given instructional treatment. Examples of some of these

personological variables most commonly investigated include general intelligence, anxiety, achievement need, and others. Treatments referred to any systematic variation in the pace or style of instruction that might be expected to interact with the learner variable of interest. And an aptitude-treatment interaction (ATI) was defined as the interaction between individual differences among student aptitudes and the effects of various instructional treatments.

It was, and still is, intuitively appealing to think that some students could be expected to perform better under one set of instructional conditions while others required a different set for optimal performance. All that remained was to delineate those interactions; what instructional treatments were best for what types of learner characteristics?

There ensued some 10 years of research before the question was raised as to why the reasonable assumptions of ATI were not generating the anticipated empirical support. Many ATI studies resulted in no significant differences between groups; others which reported interactions proved to be difficult, and sometimes impossible, to replicate under similar conditions.

Reviewers have offered a variety of explanations, often in the form of criticisms, to account for this lack of consistent findings. According to Jonassen (1982), for example, ATI research has been largely atheoretical. Empirically conceived without a supportive conceptual base, many studies have resulted in a shotgun approach to identifying learner variables and instructional treatments. Tobias (1976) pointed out a problem

with regard to researchers' conceptions of "abilities" and "aptitudes." There is not only lack of agreement as to what a given aptitude means, there is inconsistency in the way investigators have chosen to measure it. This being the case, it is hardly surprising that studies have produced conflicting results.

Other reviewers have noted problems with adequately defining instructional methods being employed as treatments (Tobias, 1981; Jonassen, 1982) and with generalizing laboratory based studies to classroom contexts (Cronbach, 1975; Jonassen, 1982). Instructional treatments, for example, have more often been characterized by such labels as "conventional" vs. "innovative," or "permissive" vs. "directive," than they were defined by what was actually varied across groups that could be expected to influence student processing differentially. The generalizability problem is potentially more serious. Learning may be so context-specific as to preclude the possibility of a general theory of aptitude-treatment interactions. Both Cronbach (1975) and Snow (1977) suggest that local instructional theories dealing with small segments of the curriculum would be a more realistic goal.

The Patterns of the Present

Perhaps in response to the problems identified in early ATI research, at least two developments have emerged in more recent studies. The first is an increased recognition of the role of prior knowledge as an aptitude variable. According to Tobias (1976), a consistent finding of ATI studies was that students'

familiarity with the subject matter being taught is important. The higher students' familiarity with the material, the less they needed various types of instructional support, and this was true regardless of any other intervening personological variables.

This result clearly accords with recommendations deriving from current instructional theory. "When educational programs are designed to be adaptive to individual differences, assessing the kind and extent of prior knowledge of students is the most important step to take at the beginning of each new unit of instruction" (Gagne, 1985, pp. 257-258). In practice, this could suggest the development of short vs. elaborated lessons to match the learners' levels of prior knowledge, with the elaborated lessons containing more of the "events of instruction" (Gagne, 1985) to support learning. The more experienced, independent learner, in other words, "will have learned to supply most or all of these supporting events on their own initiative" (Gagne, 1985, p. 256).

The question of what one should actually include in instruction leads to the second, important development in recent ATI research. Investigators are more precisely defining their instructional treatments, with attention to presumed effects on student information processing, than was true in the past. Berliner (1983), for example, developed a taxonomy of "activity structures" to promote investigation of what goes on in elementary school classrooms. McCombs and McDaniel (1983) link instructional strategies with cognitive and affective learning strategies of students to suggest variations in lesson parameters. Others define variations in methods, media, and

strategies to influence processing load (Snow, 1977; Clark, 1982), disparity (Rothkopf, 1981), or macro-processes (Tobias, 1982).

Grounding treatment variations in cognitive information processing theory has also focused attention on the different processing requirements of various types of content. In other words, learning one type of content requires a certain set of mental operations, while learning something different might require a different set of mental operations. This is again consistent with current instructional theory (eg., Gagne, 1985; Merrill, 1983). Jonassen (1982) proposes that content-treatment interactions (CTI), as opposed to aptitude-treatment interactions, provide a heuristic for researchers and designers. He contends that this approach, while perhaps not as attentive to certain kinds of learner differences, is more practical, cost-effective, and likely to be productive in terms of curriculum and product development than the ATI approach.

A Forecast for the Future

There are at least two scenarios we might draw for the future based on the preceding discussion. (And they are not necessarily mutually exclusive.) The first pertains to ATI research specifically and the second to the more general concerns about the implications of such research for instructional design.

It seem certain that further progress in demonstrating reliable aptitude-treatment interactions hinges on our ability to more clearly define what we are studying, both in terms of aptitude and in terms of treatments. With regard to aptitude,

for example, it is all too easy to use an available score (such as GPA or SAT) to represent an aptitude (such as general ability) and make an ATI prediction when neither the aptitude nor its measure are perhaps the most appropriate for our purpose. If, in fact, general ability is the aptitude of interest, then a more valid measure should be utilized. On the other hand, it is conceivable that GPA may reliably predict performance in some variety of treatments. In that case, description of what the GPA actually measures might be important, rather than it masquerading as a measure of general ability.

With regard to treatments, we are certainly heading in the right direction when we analyze them in terms of specific instructional events and what processes in students these events are designed to support. Clark (1982), for example, cites a study in which a lecture-recitation method was expected to place lower processing burdens on students than was an inquiry method. The opposite, however, turned out to be true. Why? The lecture-recitation method in actuality left students "on their own," whereas the inquiry method provided detailed guidelines and instructional support.

Finally, it has been noted here as well as elsewhere that ATI researchers should pay greater attention to social and contextual variables that may affect ATIs. Perhaps this along with systematic linking of the capabilities of students with specific features of instruction may yet yield the promised results of ATI research.

This could be the end of the paper. However, I made a

promise to re-examine the inherent belief with which this paper was begun, namely, that adapting instruction to individual differences among students, on the basis of ATI research results, is a desirable goal. This belief has already been called into question by Jonassen's (1982) proposal to adopt a CTI approach instead of an ATI approach. A CTI approach emphasizes the processing demands of content to be learned and the implications of those demands for the design of instruction. Then, rather than produce a series of instructional methods to match learner characteristics, Jonassen suggests the "one best method" be progressively modified on the basis of information about learners to make it more uniformly effective. Since this type of approach is, I think it is safe to say, at the core of many instructional design models, perhaps we are being unfairly criticized when the charge is leveled at us that we do not effectively account for individual differences.

Another perspective is offered by Parkhurst and McCombs (1979). They examined the practical implications of adapting instruction to individual differences among learners and concluded, "...for most of us, the time and expense involved in alternative module making is not worth taking unless the existing instructional treatment or module causes large or alarming student failure rates or excessive variations in the criterion variable" (p. 34). They go on to provide a working model for making decisions about whether to employ alternative modules and, further, how one might go about designing, evaluating and implementing them.

In conclusion, perhaps all is not "rotten in the state of

Denmark." Instructional design models already focus attention on the needs of learners, and to a large extent, provide for these needs effectively in well designed instruction. However, not to rest on our laurels, ATI research is improving and may yet meaningfully inform our theories and models.

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